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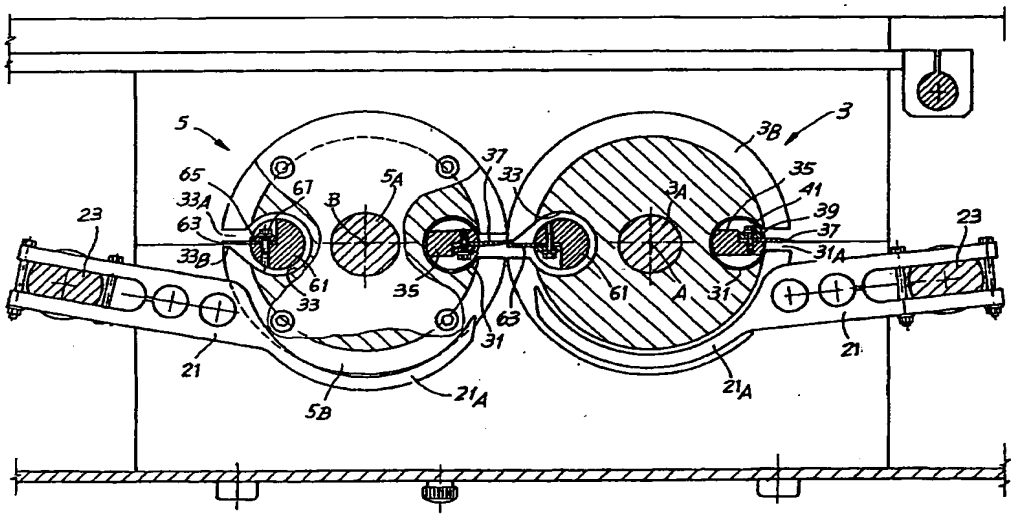
(54) Title: DEVICE FOR AND METHOD OF FOLDING SHEET MATERIAL



(57) Abstract: A description is given of a folding device for folding a web material (N) along transverse folding lines, comprising a pair of counter-rotating folding cylinders (3, 5) adjacent to each other with parallel axes, at least one folding blade (37) being placed in a first of said cylinders, and at least one gripping member being placed in the second of said cylinders, this gripping member comprising an oscillating shaft (61) and a stop (33B) for gripping the web material which is inserted into said gripping member by said folding blade. The gripping member also comprises an elastic strip (63) carried by said oscillating shaft (61), this strip interacting with the stop on the corresponding folding cylinder.

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DEVICE FOR AND METHOD OF FOLDING SHEET MATERIAL

Description of **WO0162651**

DEVICE FOR AND METHOD OF FOLDING SHEET MATERIAL
DESCRIPTION
Technical field
The present invention relates to a folding device, usable for example in paper converting machines, for folding along transverse lines a web material, for example a sheet of paper, tissue paper or the like, which can be a continuous web, possibly already folded along a longitudinal folding line. The device can also be used for folding single sheets.

Devices of this type are commonly used for the production of paper towels and handkerchiefs and the like.

The invention also relates to a machine for producing towels or other folded sheet articles, which comprises a folding device of the aforesaid type.

Additionally, the invention relates to a method of folding flat products.

Prior art
In many folding machines used in the paper processing industry, a web material is fed to a folding device which has a pair of counter-rotating cylinders. On each cylinder there are folding members which grip the web material, which is fed continuously in a direction orthogonal to the axes of the two cylinders, and fold it along folding lines parallel to the axes of the cylinders.

These machines are used, for example, for folding a web, which can already be folded longitudinally, and which is fed to the two cylinders in a zigzag configuration. The stack of material folded in the zigzag configuration is then pressed against a blade whose cutting edge is parallel to the axes of the cylinders, to divide the stack of material into two lines of towels.

A machine of this type is described, for example, in WO-A-9728076.

The folding members can be configured in different ways. In general, they have a folding blade on one of the two cylinders, which interacts with a gripping member on the other cylinder. The folding blade folds the web material along a folding line and inserts or forces it into the gripping member.

In practice, each cylinder has one or more gripping members and one or more folding blades, staggered with respect to each other such that during the synchronized rotation of the cylinders, each folding blade on one cylinder corresponds to a gripping member on the other cylinder and vice versa.

The configuration and movement of the folding blades and the gripping members can vary. An example of a configuration of these members is described in US-A-4,822,328. In this known device, the folding blades are mounted on corresponding floating shafts. Each gripping member comprises a rigid jaw mounted on a corresponding second shaft which is made to oscillate by a cam and follower. In this system, the gripping member has no elasticity.

A different configuration of the gripping member of the known type has gripping members each of which comprises an oscillating shaft driven by a cam and follower system. On the shaft, which extends parallel to the axis of the corresponding cylinder and which is housed in a seat open toward the cylindrical surface of the cylinder, there are mounted oscillating fingers, which can oscillate to a limited extent with respect to the shaft. The axis of oscillation of the fingers coincides with the axis of the shaft. Each oscillating finger is subject to the elastic action of a spiral compression spring, which is positioned between the finger and a seat formed in the cylinder. Thus each finger is elastically pressed against a fixed stop to grip the folded web material which is forced or inserted into the gripping member by the folding blade. Additionally, the shaft carrying the fingers is made to oscillate by a cam and follower system.

This system is very precise and accurate, and has considerable advantages over the systems in which the gripping members have no elasticity. In particular, it provides a good retention of the fold even in the case of web material which has variations in thickness along its transverse extension. However, it is difficult to construct, assemble and adjust, owing to the high number of parts. Moreover, the maintenance and replacement of worn or broken components are lengthy and complicated operations.

Objects and brief description of the invention
The object of the invention is to provide a folding device, a machine for producing articles made from folded sheets, and a folding method, which are simpler and more economical than the known devices, machines and methods, while having the same degree of accuracy.

A further object of the present invention is to provide a folding device which consists of a smaller number of parts, and which is easier to construct, assemble, adjust and repair.

These and other objects and advantages, which the following text will make clear to those skilled in the art, are obtained with a device in which the folding member comprises an elastic strip mounted on a shaft oscillating about its

own axis, parallel to the axis of the corresponding cylinder. The elastic strip interacts with a fixed stop.

This elastic strip, made from piano wire steel for example, replaces the set of oscillating fingers and the corresponding compression springs of conventional systems. As will be made clear subsequently, the device made in this way is very easily assembled, and permits much faster repair operations than the known devices.

Further advantageous embodiments of the device according to the invention are indicated in the attached claims.

Brief description of the drawings
The invention will be more clearly understood from the description and the attached drawings which relate to an embodiment of the invention, provided by way of example and without restrictive intent. More particularly, in the drawings,
Fig. 1 shows a front view, in partial section, of the cylinders of the folding device;
Fig. 2 shows a section throughil-II in Fig. 1;
Fig. 3 shows a section throughill-III in Fig. 1;
Fig. 4 shows an enlarged detail of the gripping member and the folding blade ;
Fig. 4A shows a detail, in a lateral view, of a portion of the elastic strip;
Fig. 5 shows a schematic plan view of a machine using the folding device of Figs. 1 to 4; and
Fig. 6 shows an enlarged detail of the gripping member in the prior art embodiment.

Detailed description of a preferred embodiment of the invention
With initial reference to Figs. 1 to 3 and 5, the general structure of the folding device and of a folded towel production machine in which it can be used are described in the first place.

Fig. 5 shows a schematic plan view of a machine for producing towels of paper or other material in folded sheet form. The machine has a folding device, indicated in a general way by 1, to which a longitudinally folded continuous web material N is fed. The folding device has a pair of counterrotating folding cylinders 3 and 5, with axes A and B parallel to each other.

The folding device will be described in greater detail with reference to Figs. 1 to 3.

The web material N is folded into a zigzag configuration by the folding device 1, and the stack P thus produced is pressed against a blade 7 which divides the stack P into two parts M, each consisting of towels folded in four.

Separator members 9, which are not an object of the present invention and which are of a known type, divide the stacks of articles M into packs, each comprising a predetermined number of articles, to be sent to the packaging machine.

As shown in greater detail in Figs. 1 to 3, the two counter-rotating folding cylinders 3 and 5 are supported by shafts 3A, 5A which are moved by a drive system which is not shown. Each cylinder 3,5 is associated with a separating comb 21, oscillating about a corresponding shaft 23. The oscillatory movement of the separating combs 21 is taken from the rotary movement of the cylinders (and is therefore synchronized with the latter movement) in a known way, by means of a transmission system which is not shown.

Each tooth of the combs 21 has a curved end portion housed in a corresponding annular groove of the corresponding folding cylinder 3,5. The annular grooves are indicated by 3B and 5B. The oscillatory movement of the separating combs is shown in the plan view of Fig. 2, where the comb associated with the folding cylinder 5 is in the position in which it is farthest from the axis of the corresponding cylinder, while the comb associated with the cylinder 3 is in the position in which it is closest to the axis of the cylinder.

Two seats 31 and 33 which are longitudinal, in other words parallel to the axis of the cylinder, are formed in each cylinder 3,5. A support consisting of a first oscillating shaft 35 is inserted into the seat 31 of each cylinder. A folding blade 37, commonly called a"wedge", is mounted on the support by means of a fixing plate 39 and securing screws 41 (see also the enlargement in Fig. 4). The folding blade or wedge 37 has recesses 37A (Fig. 1) corresponding to the annular grooves 3B or 5B of the cylinder, so that it does not interfere with the teeth of the folding combs 21. Alternatively, the folding blade 37 can be made in a plurality of portions which are aligned and spaced apart. It is also possible to make the folding blade 37 have recesses 37A while still being made in a plurality of aligned portions, for example in order to simplify assembly and/or to permit the partial replacement of the blade in case of wear or breakage. In any case, theterm"folding blade"denotes a blade consisting of a single piece or a plurality of aligned portions.

As shown in particular in the plan view in Fig. 2 and in the enlargement in Fig. 4, the screws 41 can be accessible from the exterior, by suitable orientation of the support shaft 35, through the lateral slot 31A of the seat 31, through which the blade 37 emerges from the seat and projects beyond the lateral surface of the folding cylinder.

Each of the oscillating shafts 35 supporting the folding blades 37 is pressed towards a resting position by a spiral tension spring 45 placed in the lower part of the corresponding cylinder (see Fig. 3), and secured at one end to a block 47 fixed to the folding cylinder and at the opposite end to a bracket 49 locked on the shaft 35. The bracket 49 and the shaft 35 are pressed by the spring 45 against a stop 51 integral with the corresponding folding cylinder 3 or 5, which determines the angular resting position of the folding blade 37.

Each shaft 35 is caused to oscillate, during operation, by the interference between the folding blade and the gripping

member, which is described below, and which is housed in the seat 33 in the opposite cylinder (as shown for the folding blade of the cylinder 5).

In the seat 33 of each folding cylinder 3,5 there is placed a second oscillating shaft 61, which has a flat 61A. An elastic strip 63 is applied to the flat61A and has, in the same way as the folding blade 37, recesses 63A corresponding to the annular grooves 3B or 5B of the corresponding folding cylinder (see Fig. 1 and Fig. 4A), to prevent interference with the folding combs 21 during the rotation of the cylinders. The elastic strips 63 can also be made in a plurality of portions aligned and spaced apart, instead of with recesses 63A. Alternatively, they can be made in a plurality of aligned portions while still having recesses 63A, to facilitate replacement. The term "elastic strip"denotes in a general way a single strip or a strip consisting of a plurality of portions.

The strip 63 is fixed on the oscillating shaft 61 by means of a fixing plate 65 and securing screws 67, on the flat 61A. The securing screws 67 engage in laterally open slots 63B, shown in particular in the enlarged detail in Fig. 4A, which shows a lateral view of a portion of the strip 63. The slots 63B allow the strip 63 to be extracted from its seat when the screws 67 have been slackened, without the necessity of completely removing the screws. A similar mounting system, with open slots, is provided for the folding blade or wedge 37.

The strip 63 extends radially approximately up to the lateral cylindrical surface of the corresponding folding cylinder 3 or 5, without projecting beyond this, and extends into a longitudinal aperture or slit 33A of the seat 33. As shown, in particular, in Fig. 2 and in the enlargement in Fig. 4, by suitable angular orientation of the oscillating shaft 61 the securing screws 67 are made accessible from the exterior through the aperture 33A and allow the elastic strips 63 to be mounted, removed and repaired without the need to dismantle the cylinder and the oscillating shaft 61.

Each elastic strip interacts with a stop 33B formed by an edge of the longitudinal aperture 33A of the seat 33, so that the web material N inserted by the folding blade 37 is gripped between the elastic strip 63 and the fixed stop 33B, as shown in particular in the enlargement in Fig. 4. Each elastic strip 63 and the corresponding fixed stop 33B form the gripping member for the web material.

The oscillatory movement of the shaft 61 is produced, in the illustrated example, by a grooved cam 73 interacting with a roller 69 carried by an arm
71 (see Fig. 3) integral with the shaft 61. Alternatively, it is possible to use a disc cam with a follower pressed elastically, in the way used to obtain the movement of the oscillating shaft 35.

The operation of the device described above is essentially similar in its general characteristics to that of conventional devices: the flat material is fed between the two counter-rotating folding cylinders 3,5 and is cyclically folded by one of the folding blades 37 which forces or inserts the web material between the elastic strip 63 and the stop 33B. The elastic strip 63 presses the folded area of the web material against the fixed stop 33B. The material is gripped until the folding line reaches a suitable angular position, where the gripping member releases the web material which is separated from the corresponding combs 21 and pushed toward the cutting blade 7.

The elastic strip 63 flexes when it is pressed against the corresponding stop 33B, and is made, for example, from piano wire steel, so that it has the requisite elasticity.

However, the gripping member has a much simpler structure than that found in conventional devices, as demonstrated by a comparison of Figs. 2 and 4 with Fig. 6, which shows in detail the gripping member according to the prior art. In the conventional device of Fig. 6, fingers 101 are pivoted within the oscillating shaft, which is again indicated by 61, and are free to move through a few degrees with respect to the shaft. Each finger is pressed elastically against the stop, again indicated by 33B, by a corresponding spiral compression spring 103 held in a seat 105 by a headless screw 107. The end of the compression spring 103 projecting from the seat 105 interacts with the corresponding finger 101 and is held by a pin 109. The elasticity of the folding member is provided in this case by the compression springs103. It is clear that the mounting, removal and replacement of the fingers 101 of the device of Fig. 6 is very complicated. By contrast, the elastic strip 63 of the present invention imparts the same elastic action to the gripping member with a much simpler and more economical structure.

It is to be understood that the drawing shows only a possible embodiment of the invention, which can be varied in its forms and arrangements without departure from the basic concept of the invention. The presence of any reference numbers in the attached claims has the sole purpose of facilitating the reading of the claims with reference to the description and the drawings, and does not in any way limit the scope of protection.

DEVICE FOR AND METHOD OF FOLDING SHEET MATERIAL

Claims of **WO0162651**

CLAIMS

1. A folding device for folding a web material along transverse folding lines, comprising a pair of counter-rotating folding cylinders adjacent to each other with parallel axes, at least one folding blade being placed in a first of said cylinders, and at least one gripping member being placed in the second of said cylinders, said gripping member comprising an oscillating shaft and a stop for gripping the web material which is inserted into said gripping member by said folding blade, characterized in that said gripping member comprises at least one elastic strip carried by said oscillating shaft, said strip interacting with said stop, the oscillation of said shaft causing the web material to be gripped and released, and said elastic strip being flexed. by pressure against said stop during the gripping.

2. The device as claimed in claim 1, characterized in that said oscillating shaft is housed in a seat which is formed in the corresponding cylinder and which is open outwardly along a slit parallel to the axis of the cylinder, said slit forming said stop.

3. The device as claimed in claim 1 or 2, characterized in that said oscillating shaft has a longitudinal flat, on which said elastic strip is fixed.

4. The device as claimed in claims 2 and 3, characterized in that said elastic strip is fixed on said oscillating shaft by screw means accessible from the exterior through said slit for mounting and removing said elastic strip.

5. The device as claimed in one or more of the preceding claims, characterized in that at least one gripping member and at least one folding blade are positioned on each of said cylinders in angularly staggered positions, each folding blade on one cylinder being in phase with a corresponding gripping member on the other cylinder.

6. The device as claimed in claim 5, characterized in that each cylinder is associated with a separating comb for separating the folded web material from the corresponding cylinder, and in that said elastic strip and said folding blade have recesses to permit the passage of said separating combs.

7. A machine for producing folded articles from a web material, comprising: -feeding means for feeding the continuous web material ; -a folding device for folding the continuous web material in zigzag configuration; -a cutting member for cutting the folded web material in zigzag configuration, characterized in that said folding device is made according to one or more of claims 1 to 6.

8. Method for folding a web material with a folding device comprising a first folding cylinder and a second folding cylinder, on each of which is positioned at least one folding blade interacting with a corresponding gripping member on the other cylinder, wherein the web material is inserted by said folding blade into said gripping member and subsequently released by said gripping member, characterized in that said gripping member is made with an elastic strip interacting with a stop on the corresponding cylinder, and in that said elastic strip is flexed against said fixed stop to retain the web material with said gripping member.

Fig.1

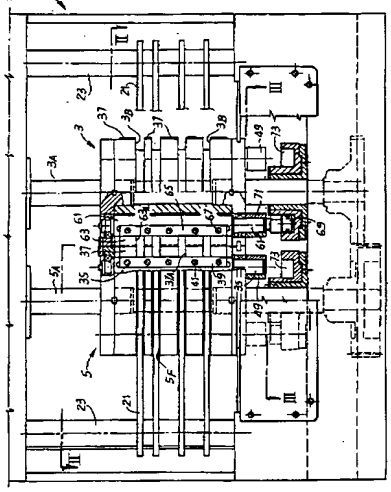


Fig. 2

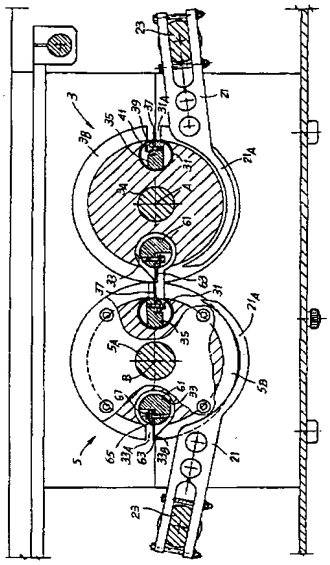


Fig. 3

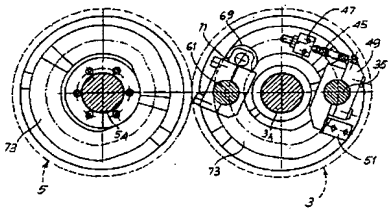


Fig. 4

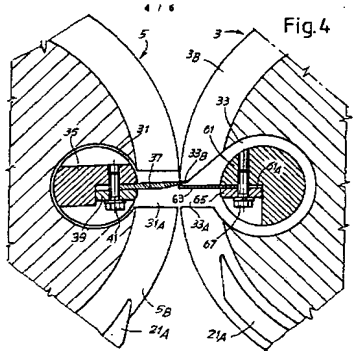


Fig. 4A

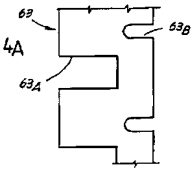


Fig. 5

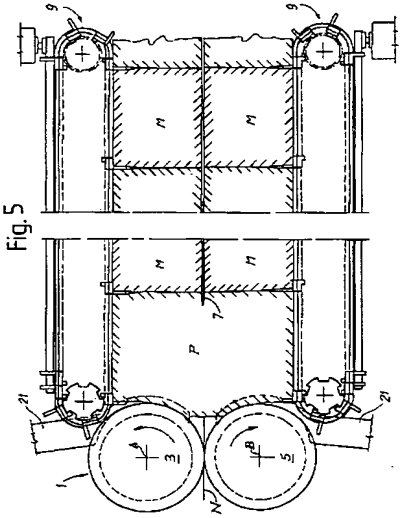
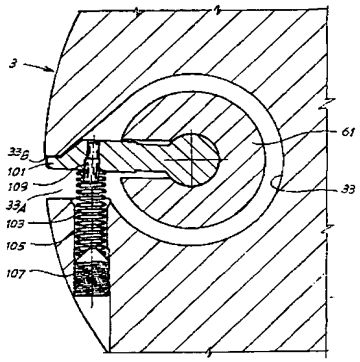


Fig. 6



State of the art